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June 2000

# Science 30

## Grade 12 Diploma Examination

Alberta
LEARNING

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*June 2000*

# *Science 30*

## *Grade 12 Diploma Examination*

### *Description*

**Time:** This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 40 multiple-choice and 12 numerical-response questions of equal value, worth 65% of the examination
- 1 short-answer question and 2 long-answer questions, worth 35% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A science data booklet is provided for your reference.

***Note:*** *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

### *Instructions*

- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- When performing calculations, use the values of the constants provided in the data booklet. Do **not** use the values programmed in your calculator.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Learning.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

## *Multiple Choice*

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

***Example***

This examination is for the subject of

**A.** science
**B.** biology
**C.** physics
**D.** chemistry

Answer Sheet

● Ⓑ Ⓒ Ⓓ

## *Numerical Response*

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

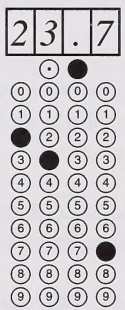
***Examples***

***Calculation Question and Solution***

The average of the values 21.0, 25.5, and 24.5 is _____.
(Record your answer to three digits in the numerical-response section on the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666
= 23.7 (rounded to three digits)

**Record 23.7 on the answer sheet** →



### *Correct-Order Question and Solution*

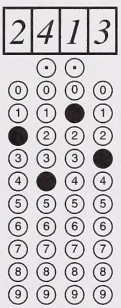
When the following subjects are arranged in alphabetical order, the order is ____, ____, ____, and ____ .

**1** physics
**2** biology
**3** science
**4** chemistry

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 2413

**Record 2413 on the answer sheet** →




### *Written Response*

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences, correct units, and significant digits where appropriate.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and made explicit.

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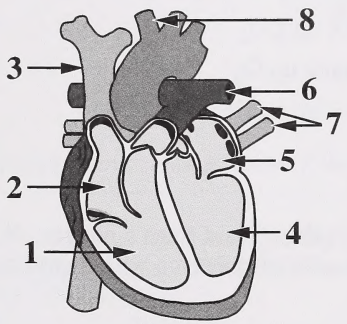
https://archive.org/details/science30grade12000albe_0

The practice of medicine requires a variety of skills and wide-ranging knowledge of biology, chemistry, and physics.

*Use the following information to answer the first two questions.*

Medical practitioners know that the pathway of blood through the heart may be monitored using cobalt-60 and X-ray machines.

**Heart**




## Numerical Response

**1.** Starting in the vena cava, blood flows through the heart in the following sequence: 3, 2, 1, 6. The blood then returns to the heart from the lungs and is pumped out to the body in the sequence _____ , _____ , _____ , and _____ .

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

**1.** The structures labelled **7** in the diagram above carry blood that is

**A.** low in $[O_2]$ to the heart

**B.** low in $[O_2]$ to the lungs

**C.** high in $[O_2]$ to the heart

**D.** high in $[O_2]$ to the lungs

2. In the blood, oxygen is primarily carried by

   **A.** plasma
   **B.** platelets
   **C.** red blood cells
   **D.** white blood cells

3. In the muscle tissues of the body, capillaries deliver

   **A.** $O_2$ and pick up $CO_2$
   **B.** wastes and pick up $CO_2$
   **C.** nutrients and pick up $O_2$
   **D.** wastes and pick up nutrients

4. A needle is used to collect blood from a patient. When it is poked into the patient's arm, the needle stimulates a withdrawal reflex. The reflex arc that results could be written as

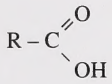
   **A.** stimulus → sensory neuron → motor neuron → response
   **B.** stimulus → motor neuron → sensory neuron → response
   **C.** response → sensory neuron → motor neuron → stimulus
   **D.** response → motor neuron → sensory neuron → stimulus

5. The collection of blood from a patient can cause stress on the patient's body. The influence of stress on a body causes the

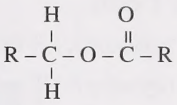
   **A.** sympathetic system to increase heart rate
   **B.** sympathetic system to decrease heart rate
   **C.** parasympathetic system to increase heart rate
   **D.** parasympathetic system to decrease heart rate

6. Which of the following substances, if absorbed into the blood, would **most likely** cause a drop in the blood's pH?

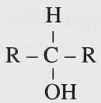
**A.**



**B.**



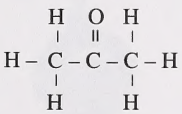
**C.**



**D.**

*Use the following information to answer the next question.*

Some people with diabetes mellitus need to take daily injections of insulin in order to prevent the following harmful substance from forming in their blood.



7. The name of this harmful substance is

**A.** propanal

**B.** propanol

**C.** propanone

**D.** methyl methanoate

8. The immune system not only combats viruses and bacteria, it also protects the body from cancer. The type of white blood cells that destroy cancer cells are

**A.** helper B cells

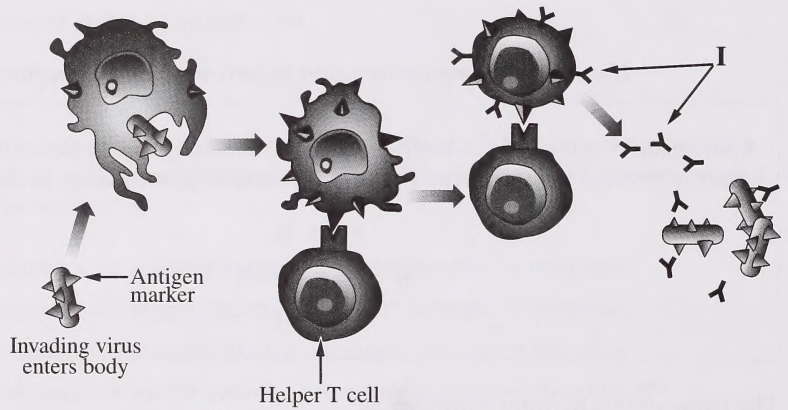
**B.** helper T cells

**C.** killer (cytotoxic) B cells

**D.** killer (cytotoxic) T cells

*Use the following information to answer the next question.*

**An Immune Response**




9. The Y-shaped proteins, labelled **I** in the diagram, are

**A.** antigens

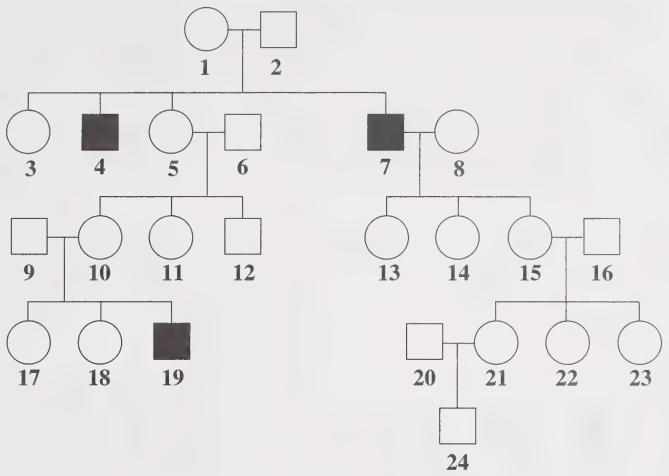
**B.** antibiotics

**C.** antibodies

**D.** anticodons

*Use the following information to answer the next two questions.*

**Pedigree Chart for the Inheritance of Colourblindness**



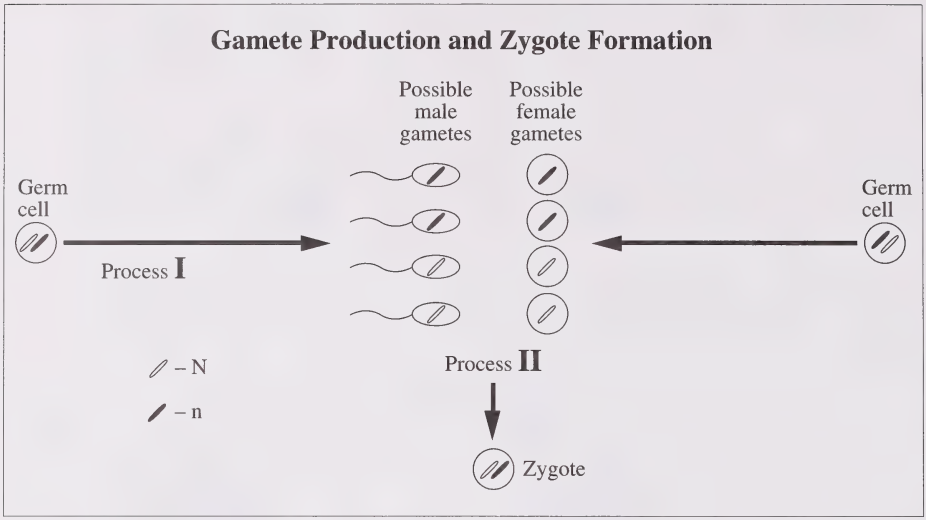

**10.** The phenotype of individual **7** is that of a

**A.** normal male
**B.** normal female
**C.** colourblind male
**D.** colourblind female

**11.** A doctor who provides genetic counselling notes that in the pedigree chart above, colourblindness is

**A.** sex-linked
**B.** heterozygous
**C.** homozygous recessive
**D.** homozygous dominant

*Use the following information to answer the next two questions.*

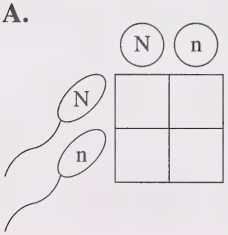



**12.** Process **II** in the diagram represents

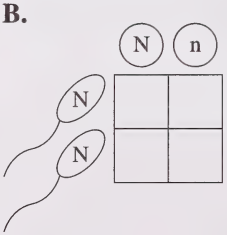
**A.** mitosis
**B.** meiosis
**C.** fertilization
**D.** nondisjunction

**13.** To predict the genotypes of the offspring from the germ cells shown above, which of the following Punnett squares should be used?

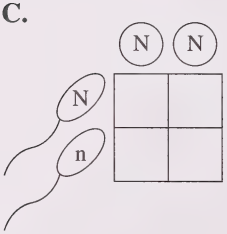
**A.**



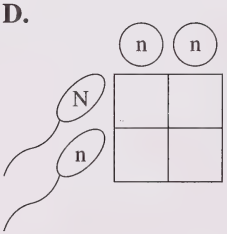

**B.**




**C.**




**D.**

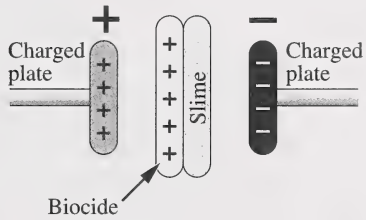


*Use the following information to answer the next two questions.*

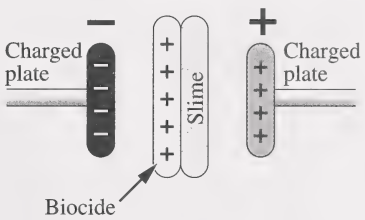
Biofilm bacteria cause a variety of medical and industrial problems. This bacteria grows as a thin organic layer on many types of inert surfaces, from water pipes to prosthetic implants. Under certain circumstances, the bacteria may develop into an infection or cause structural damage. When this happens, the biofilm grows a protective slime. Researchers are testing low-level electrical fields to force antibodies or biocide solutions through the biofilm's protective slime in order to directly attack the underlying bacteria.

**14.** In order to force a biocide solution through the slime, the biocide solution is positively charged and placed in an electrical field. The arrangement that would be used to move the biocide through the slime is

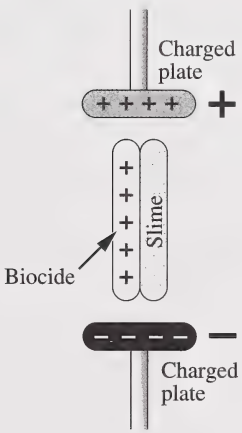
**A.**



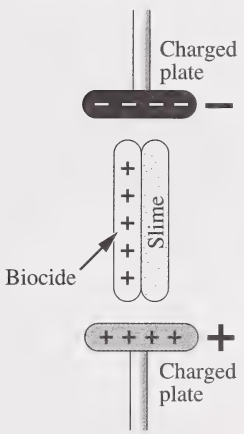

**B.**




**C.**




**D.**




**15.** What electric-field strength would be produced by charged parallel plates 0.0500 m apart if the potential difference between them is 7 500 V?

**A.** $5.75 \times 10^{-7}$ V/m

**B.** $6.67 \times 10^{-6}$ V/m

**C.** $1.50 \times 10^{5}$ V/m

**D.** $2.70 \times 10^{16}$ V/m

**16.** When hospital waste is incinerated, dioxins and furans are released. Dioxins and furans are families of compounds that

**A.** deplete the ozone layer

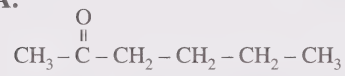
**B.** biomagnify in food chains

**C.** increase the fertility of soil

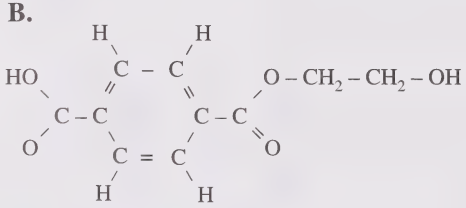
**D.** develop pesticide resistance in insects

**17.** Dioxins are polychlorinated hydrocarbons. Which of the following molecules represents a dioxin?

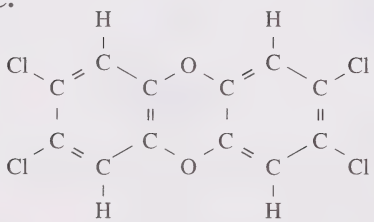
**A.**



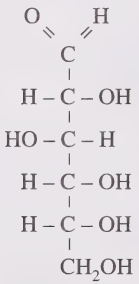
**B.**



**C.**



**D.**



The Slowpoke-2 reactor at the University of Alberta is used to study nuclear reactions, analyze chemical samples, and produce radioactive isotopes.

**18.** In the Slowpoke-2 reactor, the isotope barium-141 could be produced from barium-137 by

**A.** splitting strontium-95
**B.** the absorption of four neutrons
**C.** the addition of energy to the barium-137
**D.** removing neutrons from promethium-145

**19.** When samples are removed from the reactor, they release gamma radiation. Compared with light, this radiation has a

**A.** lower frequency and a longer wavelength
**B.** lower frequency and a shorter wavelength
**C.** higher frequency and a longer wavelength
**D.** higher frequency and a shorter wavelength

**20.** The inner shield of the Slowpoke-2 reactor is made of beryllium. The beryllium bounces neutrons back into the chamber to make a reaction possible. The relationship between beryllium and the neutrons could be compared with a

**A.** mirror reflecting light
**B.** kettle of cold water heating on a hot stove
**C.** tablespoon of sugar dissolving in hot coffee
**D.** swimmer diving into water in a swimming pool

*Use the following information to answer the next question.*

**The Release of a Neutron by Beryllium**

$$^{0}_{0}\gamma + {}^{A}_{B}\text{Be} \rightarrow {}^{7}_{B}\text{Be} + {}^{C}_{D}\text{n}$$

**Numerical Response**

**2.** A beryllium reflector absorbs gamma radiation, which causes neutrons to be released. For each of the letters given in the equation above, provide the number that would balance the equation.

**A** _____ (Record in the **first** column.)
**B** _____ (Record in the **second** column.)
**C** _____ (Record in the **third** column.)
**D** _____ (Record in the **fourth** column.)

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

---

**21.** The Slowpoke-2 reactor is sometimes used to analyze water samples in order to determine the level of chlorine atoms in water. A relatively high level of chlorine atoms may indicate the presence of

**A.** ozone
**B.** alcohols
**C.** phosphates
**D.** dioxins and furans

A space station provides an environment for many kinds of observations.

**Numerical Response**

**3.** At one point in its orbit, a space station is $6.78 \times 10^6$ m from Earth's centre. At this position, the gravitational field strength of Earth on the space station is _____ N/kg.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

*Use the following information to answer the next question.*

**Some Types of Electromagnetic Radiation**

**I** Visible light
**II** Shortwave
**III** Ultraviolet
**IV** Infrared

**22.** The electromagnetic radiation (EMR) emitted by stars includes

**A.** type I only
**B.** types I and II only
**C.** types I, II, and III only
**D.** types I, II, III, and IV

---

**Numerical Response**

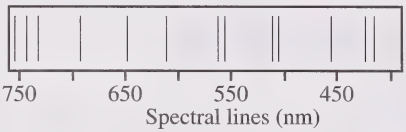
**4.** The frequency of a light wave with a wavelength of $6.31 \times 10^{-7}$ m is _____ $\times 10^{14}$ Hz.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

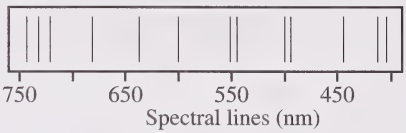
*Use the following information to answer the next question.*

**Iron Spectra**

**Normal Spectrum of Iron**




**Spectrum of Iron from an Unidentified Object**




**23.** When comparing a normal spectrum of iron with a spectrum of iron from an unidentified object in space, scientists found that the unidentified object exhibited

**A.** red shift, which indicated that the object was moving toward the space station

**B.** blue shift, which indicated that the object was moving toward the space station

**C.** red shift, which indicated that the object was moving away from the space station

**D.** blue shift, which indicated that the object was moving away from the space station

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## Numerical Response

**5.** The Mars rover vehicle, Sojourner, is powered by a solar panel. If the panel produces 1.20 A at 13.5 V, the power produced by the panel is _____ W.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

*Use the following information to answer the next four questions.*

Researchers on a space station compared the growth rates of identical plants in two terrariums. In one terrarium, the atmosphere simulated Earth's atmosphere. In the other terrarium, the atmosphere was maintained at 500 ppm of $CO_{2(g)}$, which is significantly higher than the level in Earth's atmosphere.

**24.** The responding variable in this experiment was the

**A.** temperature
**B.** amount of sunlight
**C.** growth rate of plants
**D.** concentration of carbon dioxide

**Numerical Response**

**6.** The pH of a soil sample in one of the terrariums was 6.80. The hydronium ion concentration in this sample was _____ $\times 10^{-7}$ mol/L.

(Record your **answer to two digits** in the numerical-response section on the answer sheet.)

**25.** The researchers adjusted the pH of the soil to 7.80. At this pH, the colour of bromothymol blue would be

**A.** red
**B.** blue
**C.** green
**D.** yellow

## Numerical Response

**7.** A solution of $NaOH_{(aq)}$ was used to adjust the pH of the terrarium. If 16.5 mL of 1.25 mol/L $HCl_{(aq)}$ will neutralize a 10.0 mL sample of $NaOH_{(aq)}$, the concentration of the $NaOH_{(aq)}$ must have been _____ mol/L.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

---

**26.** Some plants have been developed with toxin-producing genes that can kill specific insects. The technology **most likely** used in the development of these insect-resistant plants is

**A.** cloning

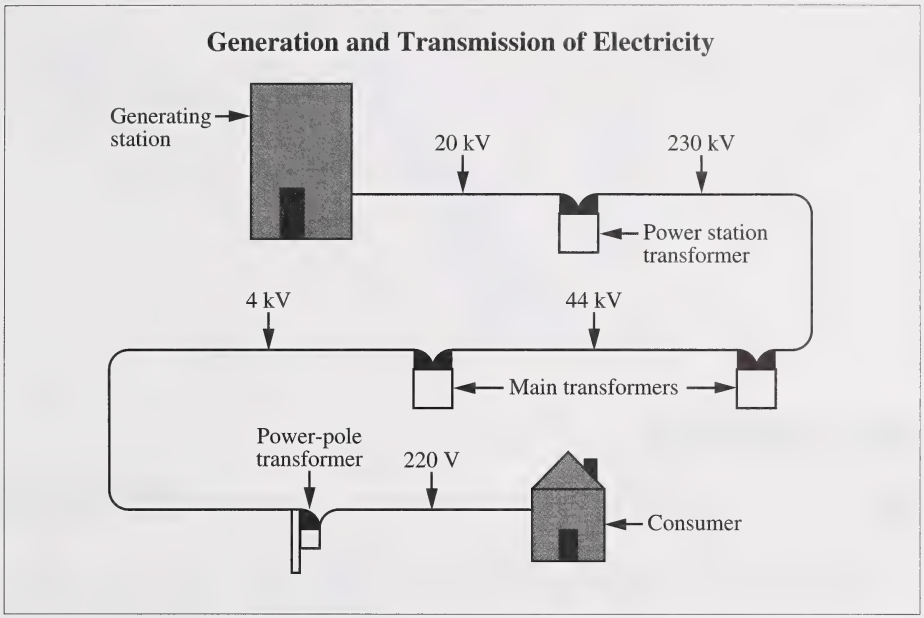
**B.** embryology

**C.** recombinant DNA

**D.** DNA fingerprinting

A variety of technologies can produce electrical energy in rural areas.

*Use the following information to answer the next two questions.*




**27.** Just before the electricity reaches a consumer, it passes through a power-pole transformer that reduces the voltage from 4 kV to 220 V. In this transformer,

**A.** the current is changed from direct current to alternating current

**B.** the current is changed from alternating current to direct current

**C.** there are more windings on the secondary coil than on the primary coil

**D.** there are more windings on the primary coil than on the secondary coil

**28.** Electricity following the pathway depicted in the diagram is transmitted from the power station transformer as

**A.** AC with low amperage and high voltage

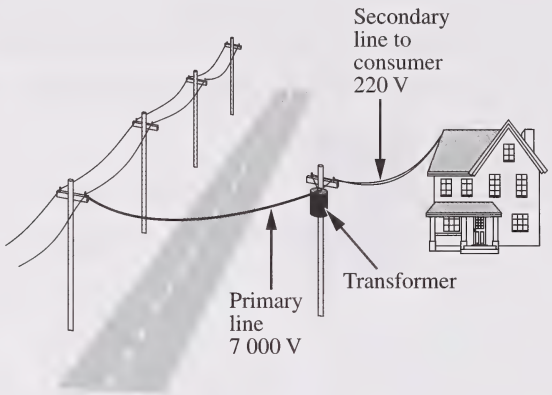
**B.** AC with high amperage and low voltage

**C.** DC with low amperage and high voltage

**D.** DC with high amperage and low voltage

*Use the following information to answer the next question.*

A local power transmission line supplies a primary voltage of 7 000 V to a transformer that steps down the voltage to 220 V in a secondary line to the consumer.

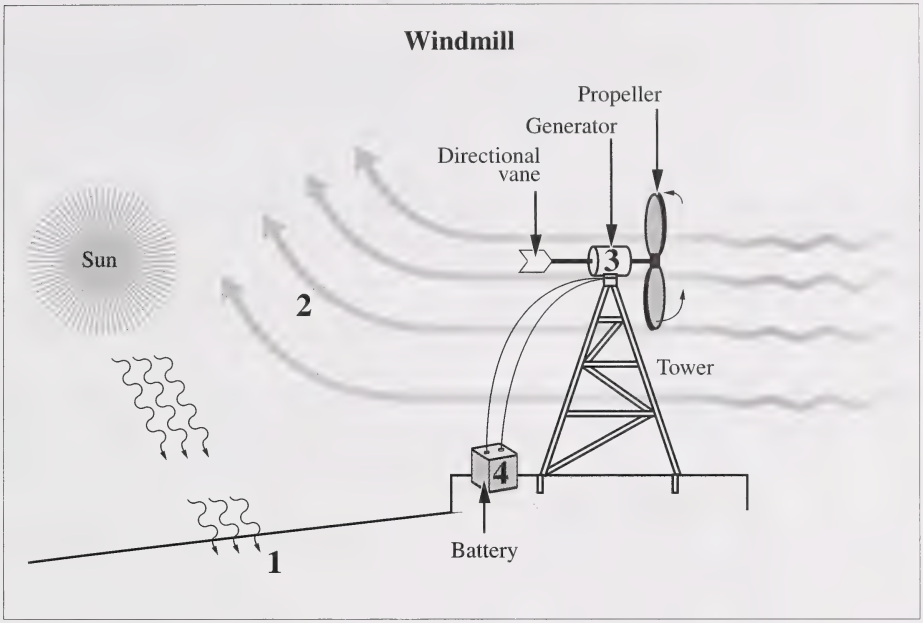



**Numerical Response**

**8.** If the current in the secondary line is 10.0 A, then the current in the primary line is _____ $\times 10^{-1}$ A.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

*Use the following information to answer the next question.*




**Numerical Response**

**9.** Some farms use windmills to supplement their electrical power supply. Match each of the energy conversions numbered above with its appropriate description below. Use each number only once.

| | | |
|---|---|---|
| Electrical to chemical | _____ | (Record in the **first** column.) |
| Solar to heat | _____ | (Record in the **second** column.) |
| Heat to kinetic | _____ | (Record in the **third** column.) |
| Mechanical to electrical | _____ | (Record in the **fourth** column.) |

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

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**29.** A high-speed windmill can utilize a maximum wind power of $6.22 \times 10^2$ W. If the windmill turned a generator that was 28.0% efficient, then the actual electrical power output would be

**A.** $1.74 \times 10^2$ W

**B.** $4.48 \times 10^2$ W

**C.** $1.74 \times 10^4$ W

**D.** $4.48 \times 10^4$ W

*Use the following information to answer the next two questions.*

A company in Detroit, Michigan, produces photovoltaic shingles for roofs. If these shingles are applied to one-third of a roof and if they are supplied with six hours of sunlight per day, they can power the average household.

**30.** The purpose of photovoltaic cells is to enable sunlight to be transformed directly into

**A.** kinetic energy
**B.** thermal energy
**C.** electrical energy
**D.** mechanical energy

**31.** Photovoltaic cells produce electrical energy that can be stored in batteries. This process of storing energy converts

**A.** AC to thermal energy
**B.** DC to thermal energy
**C.** AC to chemical energy
**D.** DC to chemical energy

*Use the following information to answer the next question.*

**Circuit Materials**

Block heater

Ammeter

12 V Battery

Voltmeter

**Short Answer—5%**

A farmer wishes to determine the resistance of a block heater. Using the circuit materials above, describe how it would be possible for the farmer to do this. Draw a diagram to clarify your answer. Include formulas that would be used to solve this problem.

The efficient production and use of energy is one of the foremost concerns in society's attempts to achieve sustainable development.

*Use the following information to answer the next two questions.*

In 1995, world energy consumption was 11.4 trillion kW•h. It is projected to be 20.0 trillion kW•h by 2015.

**Statements Related to Energy Consumption**

**1** Economic growth cannot occur without energy inputs.
**2** Computers and other communications technologies require electricity to operate.
**3** Technological innovation will contribute to efficiencies in energy conversion.
**4** Developing countries require extensive electrification projects.
**5** Refrigerators and electric ranges are among the first appliances purchased by people who have electricity.
**6** Enormous capital costs are associated with the development of electrical generating stations.

**32.** The statement that describes conditions that will produce economic growth while preserving the environment is statement

**A.** 1
**B.** 2
**C.** 3
**D.** 5

**Numerical Response**

**10.** The four statements numbered above that describe conditions which contribute to an increase in energy consumption are _____ , _____ , _____ , and _____ .

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

*Use the following information to answer the next question.*

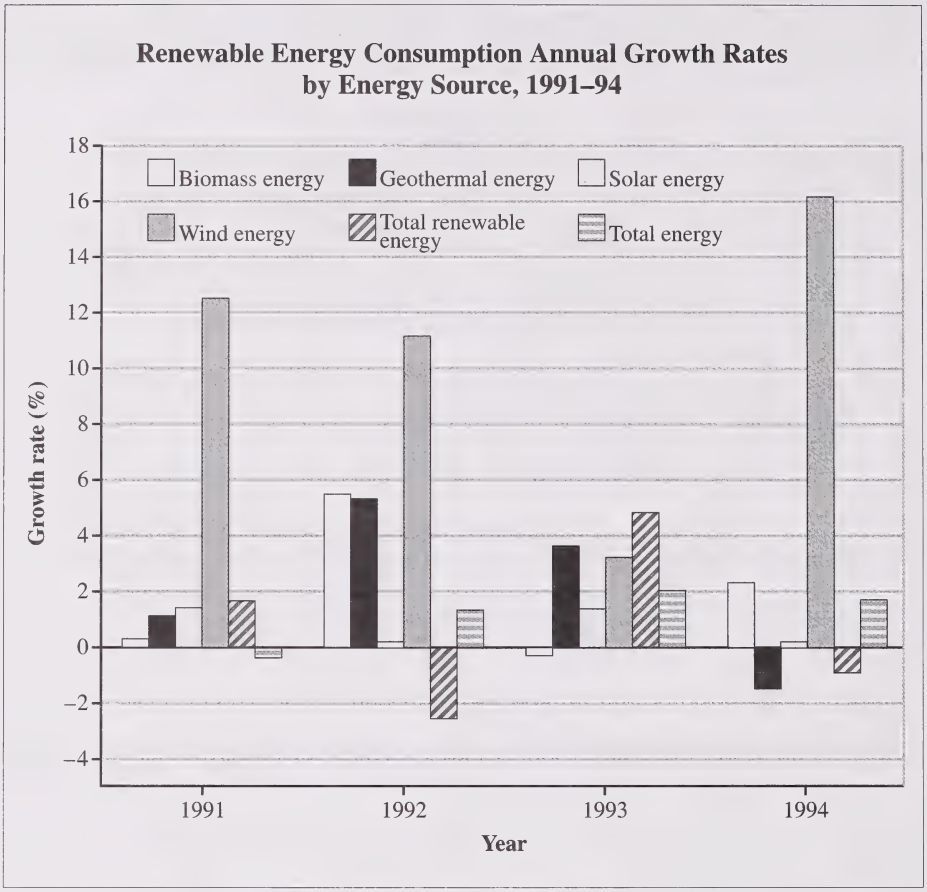
**Some Types of Pollution Released During Energy Production**

**I** Greenhouse gases
**II** Heat
**III** Radioactive wastes
**IV** Acid rain-producing chemicals

**33.** The types of pollution released during the combustion of fossil fuels are

**A.** I and IV only
**B.** II and III only
**C.** I, II, and IV only
**D.** II, III, and IV only

*Use the following information to answer the next question.*




**34.** Between 1991 and 1994, the renewable energy source with the highest growth rate was

**A.** wind energy

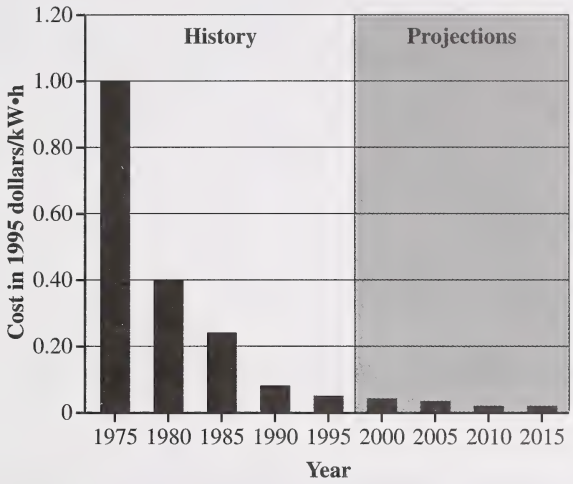
**B.** solar energy

**C.** biomass energy

**D.** geothermal energy

*Use the following information to answer the next two questions.*

**Average Cost of Wind-Powered Electricity Generation in the United States, 1975–2015**




**35.** For a household using wind-powered electricity in 1980, operating an 8.80 kW oven for 3.50 h would have cost, in 1995 dollars,

**A.** $3.50

**B.** $12.32

**C.** $350.00

**D.** $1 232.00

**36.** The **most likely** reason for the dramatic decrease in the cost of wind-powered electricity generation since 1975 is that

**A.** windmill technology has improved

**B.** the average velocity of wind has increased

**C.** the resistance in the transmission lines has decreased

**D.** materials needed to build windmills have increased in cost

**37.** The energy from tides can be used to produce electricity. Ocean tides are caused by gravitational pull on the oceans from both the moon and the sun. The greater tidal pull comes from the

**A.** sun because it is closer to Earth than the moon

**B.** moon because it is closer to Earth than the sun

**C.** sun because it is farther from Earth than the moon

**D.** moon because it is farther from Earth than the sun

## Numerical Response

**11.** A typical nuclear generating station generates 1 000 MW of power. The amount of energy produced in one day is _____ $\times 10^{13}$ J.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

*Use the following information to answer the next question.*

**Nuclear Reaction**

$$^{239}_{93}\text{Np} \rightarrow {}^{239}_{94}\text{Pu} + \mathbf{X}$$

**38.** In the above equation, the symbol **X** represents

**A.** $^{0}_{1}\text{e}$

**B.** $^{0}_{1}\text{n}$

**C.** $^{0}_{-1}\text{e}$

**D.** $^{0}_{-1}\text{He}$

**39.** One difference between nuclear reactions and chemical reactions is that in nuclear reactions,

**A.** mass is neither created nor destroyed

**B.** energy is neither created nor destroyed

**C.** the mass of the reactants is double that of the products

**D.** there is a mass difference between reactants and products

**40.** Which of the following energy converters does **not** have a nuclear reaction as its original energy source?

**A.** Tidal power plant

**B.** Solar-thermal heater

**C.** Photovoltaic battery charger

**D.** Geothermal electric generator

*Use the following information to answer the next question.*

**Some Energy Transformations**

**1** River water is used to turn a generator.
**2** Windmills produce electricity.
**3** Natural gas-fired boilers provide high-temperature steam.
**4** Glucose from an apple is respired in cells.
**5** Steam produced in a fission reactor is used to generate electricity.
**6** Water in a tidal basin is used to turn an electric generator.

**Numerical Response**

**12.** The energy transformations numbered above that have radiant energy from the sun as their original source of energy are _____, _____, _____, and _____.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

*Use the following information to answer the next question.*

**AIDS Theories**

Why does the AIDS virus kill some people so much faster than others? Why do 12% of those infected with HIV develop AIDS within five years, whereas 50% stay healthy for 10 years? Researchers want to know what makes the latter group different.

Studies show that the AIDS virus attacks a crucial variety of white blood cells called helper T cells. Healthy people have about 1 000 of these cells per cubic millimetre of blood. Most people infected with the virus initially experience a drop in their helper T cells. Then, the number of helper T cells almost levels off, and in subsequent years, the total drops slowly. Eventually, the number of helper T cells falls below 200 cells per cubic millimetre and people risk infections, the hallmark of AIDS. The researchers are fascinated by people who do not continue to lose helper T cells.

**Two Theories of Why Some People with HIV Survive Longer than Others**

1. They are genetically different.
2. They are infected with less deadly strains of the virus.

**Long Answer—15%**

**1.** **a.** Briefly describe the role of the helper T cells in the functioning of the immune system.

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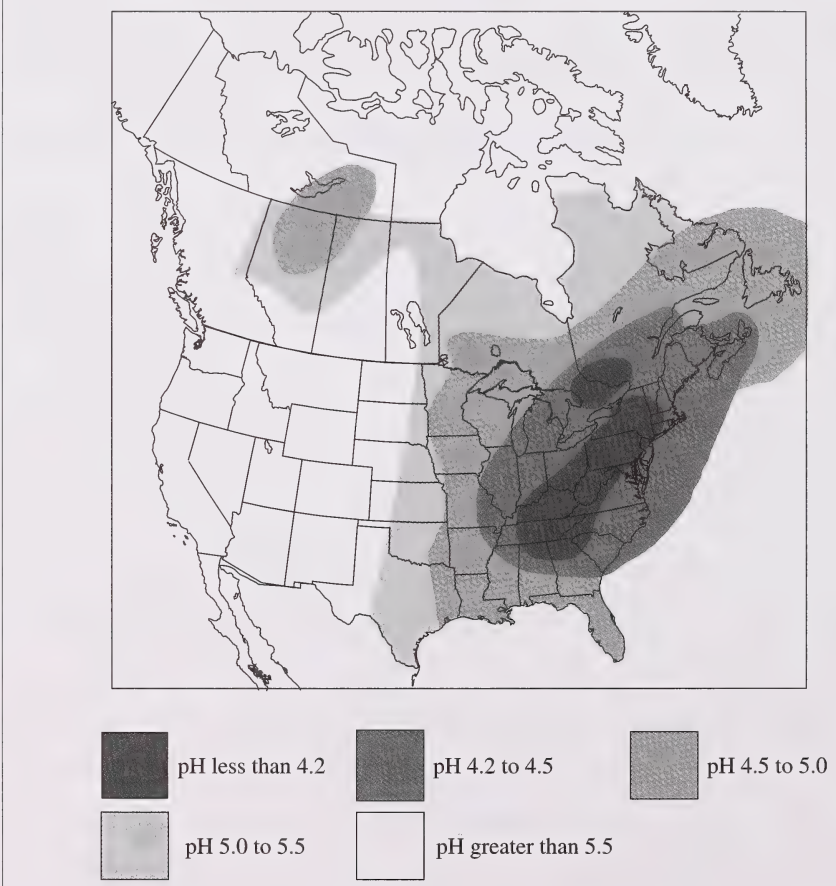
**b.** Assume that you have access to the medical records for thousands of AIDS patients from all over the world and that you have permission to use the latest in medical technology. Design a study that could test **one** of the two theories. Include a description that outlines the limitations of your study for making absolute conclusions. Organize the description of your study under the following headings.

- Problem
- Variables: Identify the manipulated (independent), responding (dependent), and controlled variables
- Hypothesis
- Procedure or Design

*Use the following information to answer the next question.*

**The pH of Precipitation in North America**



**Long Answer—15%**

**2.** Acid deposition is a major environmental concern. Give reasons for the distribution patterns of acid deposition depicted in the map. Describe the problems caused by acid deposition and analyze the causes, prevention, and treatment of acid deposition. Clarify your analysis by including some chemical equations.

*You have now completed the examination.*
*If you have time, you may wish to check your answers.*

***No marks will be given for work done on this page.***

*Fold and tear along perforation.*

***No marks will be given for work done on this page.***

*Fold and tear along perforation.*

*No marks will be given for work done on this page.*

*Fold and tear along perforation.*

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